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Dated 2 April 2003

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1. Your reference — **GW-G32957**

2. Patent application number *(The Patent Office will fill in this part)* — 0220502.9 — 03 SEP 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Eugene Howe

24 Elm Court
High Burton
Kirk Burton
Huddersfield
H88 0TB

Patents ADP number *(if you know it)* 6568463002

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — **Improvements to Cables**

5. Name of your agent *(if you have one)* — **Bailey Walsh & Co.**

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

5, York Place
Leeds
LS1 2SD

Patents ADP number *(if you know it)* — **224001**

6. If you are declaring priority from one or more earlier patent applications, give the and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / years)*

7. If this application is divided or otherwise derived from an earlier UK application, the earlier application

Number of earlier application	Date of filing *(day / month / years)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer "Yes" if:*

No

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

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See note (d)

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Description	12
Claim(s)	
Abstract	
Drawing(s)	8 + 8 for 1

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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
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11. I/We request the grant of a patent on the basis of this application

Signature [signature] Date **02.09.2002**

12. Name and daytime telephone number of person to contact in the United Kingdom **G Wood 0113 2433824**

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Improvements to Cables

The invention which is the subject of this application relates to an improvement in the provision of cables of the type which can be used for the carrying of electrical signals such as data transmission, video, audio, auxiliary data or indeed any communication data in AC, DC, analogue or digital format between two or more locations. The cable in accordance with the invention is provided in a form to improve the transfer of data in terms of improved quality reduced interference, increase in throughput/bandwidth and the like and to make the same more commercially attractive to potential purchasers while, at the same time, improving the performance of the same.

The invention and several embodiments of the same are already disclosed in the Applicant's co-pending patent application GB0205323.9 and the subject matter of this application should be read in conjunction with the previous application.

In a first aspect of the invention there is provided a data carrying cable, said cable comprising a core, said core carrying thereon or therein, a plurality of functional conductors, said conductors provided and arranged such that a series of groups of conductors are provided at spaced locations on and/or in said core wall.

Typically the groups of conductors are pairs of conductors and are referred to as such hereonin in a non-limiting manner.

In one embodiment, the core is in the form of an elongate tube or any other shape to facilitate the form and continuum of the cable conductors.

In one embodiment, the pairs of conductors are arranged to lie on the outer surface of said core tube to enable a reduction in the cross sectional area of the tube due to the placement of the conductor pairs being spaced further apart by lying on the outside of the core. In an alternative embodiment, the pairs of conductors are located within the wall of said tube.

In an alternative embodiment, the core is relatively flat in form and pairs of conductors are spaced apart along said core.

In whichever embodiment, it is envisaged that in each pair of conductors, the conductors are wound round one another so as to form a twisted pair of conductors. In practise, depending on the application type, the degree of twist of the conductors in each pair is of a specific tightness but kept as loose as possible without detracting from the performance of the cable so as to provide cost savings by reducing the lengths of the conductors by reducing the degree of twist.

Typically if the conductor pairs are less than e.g. 1mm apart then the twisting tightness of each pair will be staggered e.g. Pr1=4 twists/cm, Pr2=3 twists/cm, Pr3=2 twists/cm etc or whatever is most effective, depending on application. This will reduce the crosstalk and improve the performance.

In one embodiment each of the pairs of twisted conductors are provided at the same densities so as to remove or minimise any propagation delay in the data transferred along the cable.

In one embodiment, at least one conductor pair is provided to lie along the core substantially in parallel with the longitudinal axis of the cable core. Preferably, each of the conductor pairs provided as part of the cable is provided in a linear path in parallel with the longitudinal axis of the cable. Alternatively,

when the conductor core is an elongate tube one or more of the conductor pairs is provided wrapped around the conductor core in a substantially spiral path.

It is preferred to have the conductor pairs running in a linear path rather than a spiral path along the core as it reduces the length of conductor material required to be used to form the cable, hence reducing costs of production of the cable and in due course the selling price of the cable, without affecting the performance of the same.

In one embodiment, when the core is an elongate tube, the central port through the tube, can be used to provide further services. In one embodiment, the further services are further conductors, which may include conductor pairs, of greater or reduced c.s.a. for the carrying of further data therealong and/or can be in the form of a power supply so as to provide a single cable connection to apparatus which can provide data and power to the apparatus.

Alternatively, the core can be a tube filled with further material to give the cable added rigidity or alternatively, the core can be a solid cylinder as required.

Typically, in whatever embodiment, at least one millimetre distance is provided between adjacent conductor pairs and preferably, a distance of 2 mm or more is provided between adjacent conductor pairs so as to prevent interference between the pairs. It is possible that more twisted pairs can be added to facilitate throughput, bandwidth, speed etc, for example, if 5 pairs are introduced the spacing will be 72° between pairs; 6 pairs 60° and so on. The c.s.a. of the tube will increase in proportion to the number of pairs to maintain the spacing

required mentioned earlier in this text. The interior part may be used to extend data transfer, with or without spacers.

In addition to the changes to the conductor and cable arrangement, a further aspect of the invention relates to the provision of socket and plug arrangements for location at the ends of the said cable either in the original or amended forms as described herein.

In a further aspect of the invention there is provided a plug and socket arrangement, said plug and socket, being of matching male and female configuration respectively, the plug being arranged for location within a port defined in the socket, characterised in that in at least one of said plug and socket bodies, are located a number of conductor pairs, said conductor pairs, spaced around the body by a predefined spacing.

Typically the bodies of each of the plug and socket bodies are provided with conductor pairs mounted therein.

Typically, the spacing between conductor pairs is 360° divided by the number of conductor pairs provided in the body.

Typically, each conductor pair in a plug is located with a contact which protrudes from the external surface of the body of the plug such that when the plug is located within the socket, said metallic contact locates with a matching metallic contact mounted on the internal surface of the socket.

In one embodiment, the metallic contacts in one or other of the plug or socket are spring loaded so as to allow engagement to be ensured with the other metallic contacts which typically will be statically mounted.

Although it is envisaged that the provision of the plug and socket bodies of a substantially cylindrical form along with a locator means to ensure correct location of the plug and socket bodies on each occasion, it should also be envisaged that other shapes of plug and socket bodies can be used as long as they maintain the angular spacing between the respective conductor pairs. For example, the plug and socket shapes used can be any or any selection of square, oval, oblong, rectangular, hexagonal and the like.

In one embodiment, the cable is located with respect to the plug or socket body substantially in line with the same. Alternatively, the socket or plug body can be mounted at 90° to the longitudinal axis of the cable.

In a further aspect of the invention, there is provided a plug and socket arrangement wherein the plug and socket are both substantially planar in form, with conductor pairs from a cable connected to the plug or socket linearly spaced along said plug or socket body.

Typically, the socket is arranged with a substantially linear port defined therein for the location of the relatively planar plug therein.

Typically, either of the plug and socket assemblies described can be used in conjunction with either or both of the relatively cylindrical or linear cable arrangements described herein.

Furthermore, it is envisaged that the socket arrangements can be provided as integral parts of a surface mounting on a wall and in one embodiment, the surface mounting is universal in as much that it allows the connection of the same to linear or cylindrical cables at the rear thereof.

Specific embodiments of the invention are now described with reference to the accompanying drawings, wherein:-

Figure 1 illustrates an elevation of a length of cable in accordance with a first embodiment of the invention;

Figure 2 illustrates a cross sectional elevation of the cable in Figure 1 along line A-A;

Figure 3 illustrates an end elevation of a length of cable in accordance with a further embodiment of the invention;

Figure 4 illustrates a length of cable in accordance with a further embodiment of the invention;

Figure 5 illustrates a cross sectional elevation of the cable of figure 4 along line B-B;

Figures 6A-D illustrate embodiments of cylindrical plug and socket arrangements for use with the cable of the invention;

Figures 7A-D illustrate embodiments of relatively planar plug and socket arrangements for use with the cable of the invention;

Figures 8A-B illustrate a surface mounting for a cylindrical socket;

Figures 9A-B illustrate a surface mounting for a relatively linear flat socket; and

Figures 10A-B illustrate a combined flat and/or cylindrical cable surface mounting.

Referring now to the drawings, each illustrates an embodiment of the invention. In each case, the cable includes four pairs of conductors and the embodiments described are of particular use when using four pairs of conductors.

Referring firstly to Figures 1 and 2, there is illustrated a length of cable 2 with outer insulation, as is typically required, removed for ease of reference. In an alternative embodiment the conductors can be bonded to the outer wall of the core thus eliminating the need for the outer insulation. The length of cable 2 comprises, in addition to the removed outer insulation, a core 4 in the form of an elongate tube and four pairs of conductors 6, 8, 10, 12.

Each pair 6, 8, 10, 12, comprises two conductors 14, 16 which are illustrated with reference to conductor pair 6 only for ease of reference. Each conductor in a pair is wound round the other so as to form a twisted configuration as illustrated in Figure 1. The degree of twist used can be the same for each of the pairs 6, 8, 10, 12 or can be varied as required for use requirements but in each case, it is envisaged that the less degree of twist that can be achieved without affecting the performance, the better as it reduces the material usage, the length, the attenuation and hence increases the propagation (speed) at which the signal arrives at the intended destination. Each of the conductor pairs 6, 8, 10, 12, is provided in a linear path along the conductor core 4 in a plane substantially parallel with the longitudinal axis of the core. The linear path is preferred as it reduces the material used in comparison to the material used if the conductor pairs are required to be wound around the core. The core 4 can be formed of insulating material, flexible or rigid, and the interior port 18 as shown in Fig. 3 which runs along the length of the cable, 2, can be used to

carry further services such as, in this embodiment, a power supply 20.

It is preferred to keep the various conductor pairs and other services apart by a distance of at least one but preferably more than 2 mm depending on the thickness of the tube. If this distance cannot be maintained the power supply 20 is held in a spaced relationship within the port 18 by means of a spacer arrangement 22 which has a series of arms which engage with the inner surface of the core so as to maintain the power supply cable 20 in a fixed position with respect to the inner surface of the core.

It should be appreciated that port 18 need not be used for further services and instead, if further cable rigidity is required, the interior of the core can be filled in and/or provided with other material to improve the rigidity of the cable.

In a further and perhaps preferred embodiment, the conductor pairs 6, 8, 10, 12 are not provided on the outer surface of the core 4 but rather are provided as integral parts of the core wall as illustrated in Figure 3 which provides an end elevation of a cable in this further embodiment. In this arrangement, the conductors in each pair can be twisted as illustrated with regard to Figure 1 and each pair will follow the same path as illustrated in Figure 1 with the exception that rather than lying on the outside of the core 4, the conductor pairs are provided as integral parts of the wall of the core.

Furthermore, the interior port 18 of the core can be used in a similar manner as described with respect to Figure 2. An advantage of this arrangement is that the outer insulation 24 around the core is not required and the finished product will not be uneven due to the provision of the conductor pairs on an

external surface of the core, but rather can be relatively smooth as it simply overlies the core. Indeed, it may also be possible for the outer layer of insulation to be not required, thus providing further cost savings.

Figures 4 and 5 illustrate a yet further embodiment of the invention where, in this embodiment, rather than the core 104 being in the form of a tube, the core along the length of cable 102 is relatively flat. In this arrangement, each of the conductor pairs 106, 108 110 and 112 are again provided in a linear path parallel with the longitudinal axis of the core 104 and are spaced apart linearly. It should be appreciated that the core is provided with dimensions with respect to the conductor pairs such that the required distance of 1 or preferably more than 2 mm apart can be achieved. It is also shown how, with respect to conductor pair 106 for the purposes of illustration, in each pair, the conductors are again twisted. Typically, the conductor pairs are embedded within the core so that a relatively slim and easy to fit cable can be formed in accordance with this embodiment of the invention.

Figures 6A to D illustrate one embodiment of the plug and socket arrangement comprising a plug 102 and socket 104, with a locator key assembly 106 for location in a matching channel, not shown in the socket 104. In each of the plug and socket arrangements, there are provided four conductor pair locations 108, 110, 112 and 114 each of which is spaced 90° apart to provide the required spacing between the conductor pairs 116, 118, 120 and 122. Each of the conductor locations 108 to 114, is provided with an electrical contact 124. The contacts 124 in the plug are spring loaded so as to protrude from the external surface of the plug body such that when the same is inserted into the socket, the metallic contacts 124 contact with matching, static contacts 126 which are provided on the internal surface of

the socket body. Thus, by insertion of the plug into the socket, connection of the conductor pairs 116 to 122 can be achieved with the conductor pairs 128 to 134. Figure 6B illustrates a patch panel 136 which is a plurality of sockets 138 available for the insertion of the plugs of the type shown in Figure 6A therein to allow the connection of a plurality of conductor cables. Figure 6C illustrates how the spacing between the contacts 124 allows the spacing of the conductor pairs connected thereto. Typically the particular spacing is dependent on the number of conductor pairs to be located on the plug or socket so that, for example, if there are four sets of conductor pairs the spacing is 360° divided by four which equals 90°, if there are five conductor pairs the spacing is 72° and so on. However it is envisaged that there will always be spacing of at least 1mm but preferably 2mm between the conductor pair locations in the plug and socket arrangement.

Figure 6A illustrates the cables 136 and 138 located with respective plug and socket in a linear manner such that the longitudinal axes of the cables are in line with the longitudinal axis of the plug or socket. Figure 6B illustrates an alternative arrangement where the longitudinal axis of cable 140 is perpendicular to the longitudinal axis of the plug 142 with conductor pairs being wrapped round the plug body until they are connected to the respective contacts 124.

Figures 7A to D illustrate an alternative embodiment of the plug and socket arrangement and it should be appreciated that either embodiment of Figures 6A to D or 7A to D can be used in conjunction with flat cables or the circular cable arrangements as described with respect to Figures 1 to 5.

In Figures 7A to D, there is provided a relatively planar plug 150 and a relatively planar socket 152. The socket is provided

with an aperture, indicated by broken lines, which allows for the reception therein of the plug as indicated by arrow 154. When located, the contacts 156 contact with contacts 158 mounted at the rear of the socket and, as the contacts 156 are each located with a conductor pair 160, 162, 164, 166, so contact can be made between the cable 168 connected to the plug and a cable or other data carrier means connected to the socket at the rear face thereof. Figure 7D illustrates a patch panel arrangement whereby a plurality of sockets 170 are provided, each for location of a plug 150 as illustrated in Figure 7A. Figures 8A and B illustrate a surface mounted panel 172 which can be located on a wall with a rear protrusion 174 mounted in an aperture formed in the wall surface. This surface mounted plate, includes a socket arrangement 176 into which a plug of the type shown in Figures 6A to D can be inserted to allow contact with the contacts 178 mounted in the socket as shown. There is also provided a dust cover 180 which can be spring loaded and which can be raised to allow the plug to be inserted into the socket.

Figures 9A and B illustrate similar arrangements to that of Figure 8A and B with the exception that the socket in the front surface is arranged for location of a relatively planar socket arrangement of the type shown in Figures 7A to D. In this case, the socket 182 is provided with linearly spaced contacts 184. The rear panel 186 allows a connection to further cabling behind the wall.

Figures 9A and 9B illustrate how the external face of a socket 190 can be provided with a socket arrangement 192 of a first type but at the rear face 194 the socket can be provided to allow the connection thereto of a plug or cable arrangement of an alternative form such that, in this case, a relatively circular socket is provided on the external surface 190 and relatively planar socket or plug 196 is provided on the rear surface to suit

particular cabling requirements. It should also be appreciated that this arrangement can be reversed to suit particular requirements.

There are therefore provided improvements and adaptations to the cable of the type described in the Applicant's co-pending application wherein improved performance and reduced material usage can be achieved in accordance with the embodiments described herein.

4A

Figure 1

4PR SUC FOR DATA APPLICATIONS.

FOUR PAIR ARRANGEMENT CABLE

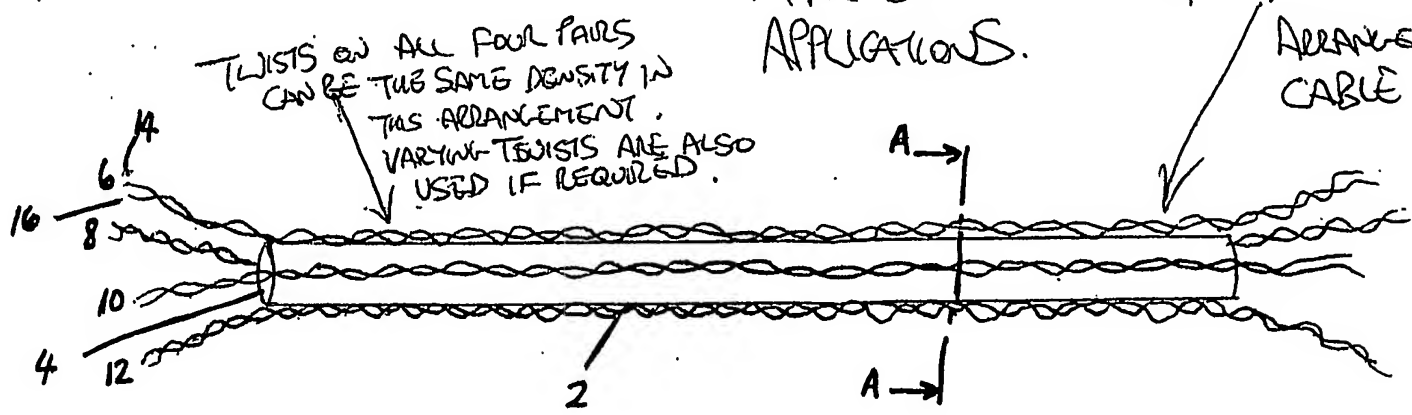
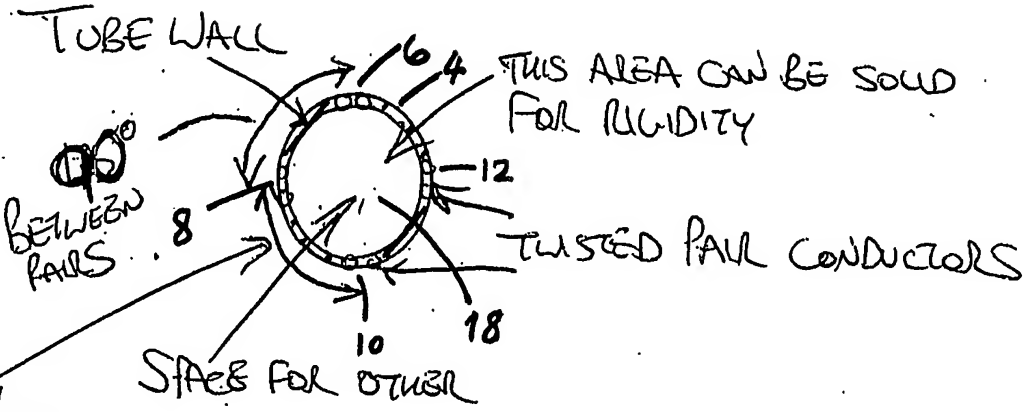


Figure 3



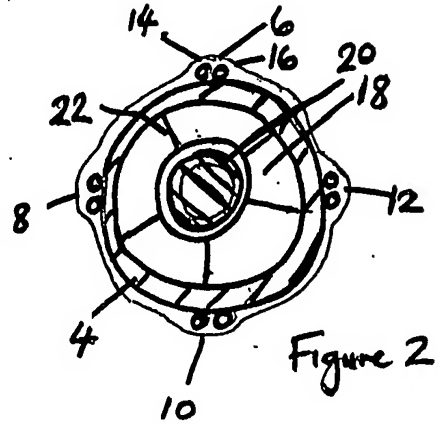


Figure 2

NOTE:- THE ABOVE ARRANGEMENT i.e. STRAIGHT PLACEMENT OF PAIRS (AS OPPOSED TO SPIRALLED) REDUCES COPPER CONTENT.

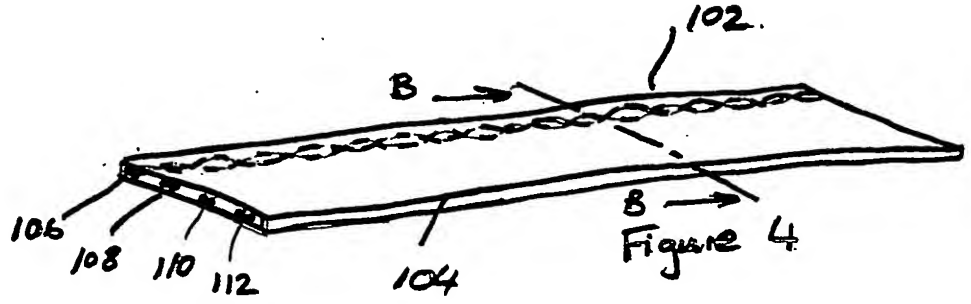


Figure 4

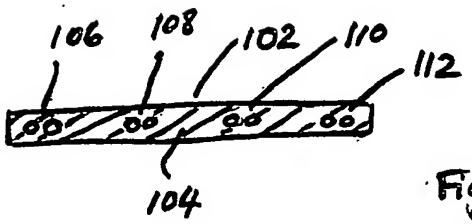


Figure 5

S.L.I.C.

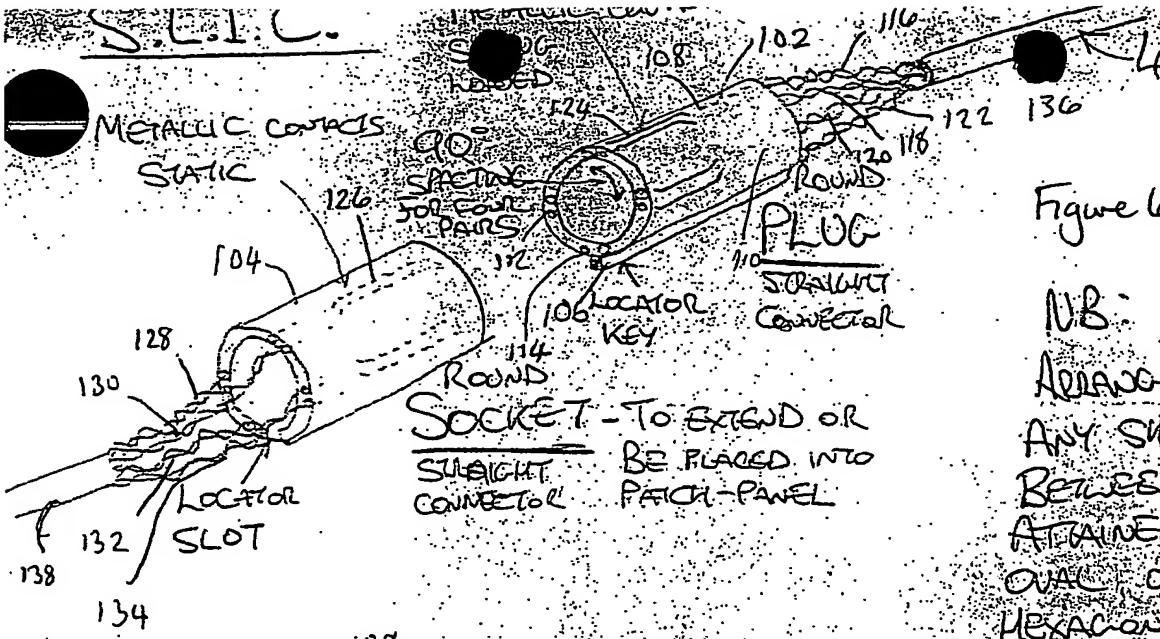
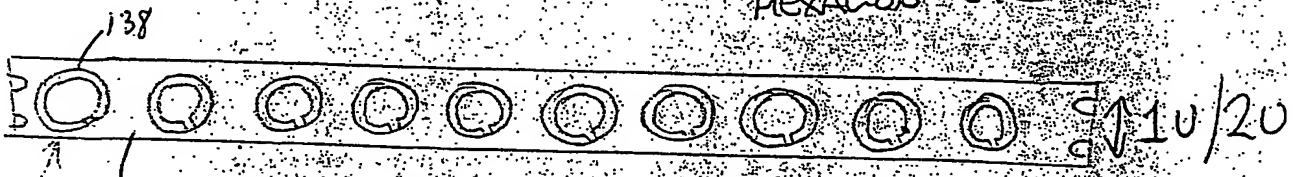


Figure 6A

NB: PLUG & SOCKET ARRANGEMENT CAN BE ANY SHAPE WHERE 90° BETWEEN PAIRS CAN BE ATTAINED. EG. SQUARE, QUAD, OBLONG, RECTANGLE, HEXAGON ETC



SOCKET MOUNTED IN PATCH PANEL

RACK MOUNT PATCH PANEL EG. 10 WAY 1U

Figure 6B

NB: EITHER/OR (OR BOTH) THE SOCKET & PLUG MAY BEAR SPRUNG/STATIC CONTACTS.

CONTACTS SPACED @ 1mm OR LESS. SPACE BETWEEN PAIRS OF CONTACTS AT LEAST 1m, 2mm PREFERABLE

eg.

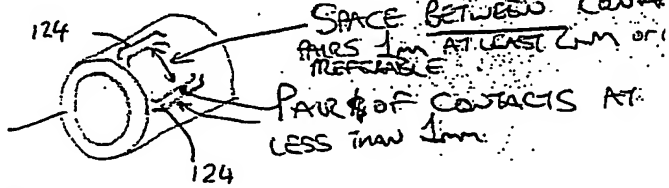


Figure 6C

S.L.T.C.

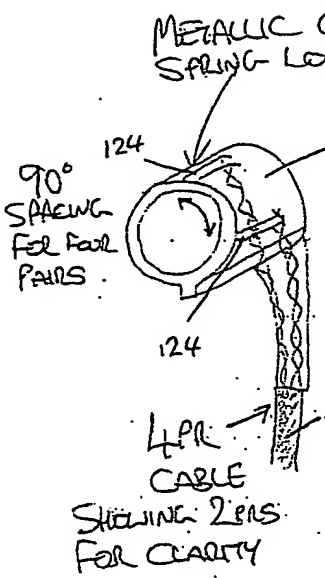


Figure 6D

PLUG
90°
CONNECTOR
(SPACE-SAVER)

SOCKET - A 90° SOCKET CAN BE USED IN WALL FACE PLATE OR OTHER AREAS WHERE SPACE IS AN ISSUE. USUALLY SPACE IS NOT OF IMPORTANCE IN PATCH PANELS. IT IS ENVISAGED THAT THE 'THROUGH/STRAIGHT' TYPE OF PLUG AND SOCKET WILL PROVIDE A HIGHER QUALITY CONNECTION

(SIMILAR TO PLUG ARRANGEMENT)

V.B. BOTH STRAIGHT & 90° PLUG/SOCKET ARRANGEMENTS HAVE BEEN SHOWN BUT 'ANY' OTHER ANGLES CAN BE EMPLOYED FOR SPECIFIC TASKS. 45° ANGLES ~~WEATHER~~ UP, DOWN, LEFT OR RIGHT IN RELATION TO THE PLUG/SOCKET POSITION (AS WITH 90° AND OTHER ANGLES) CAN BE USED

FLAT CAT.

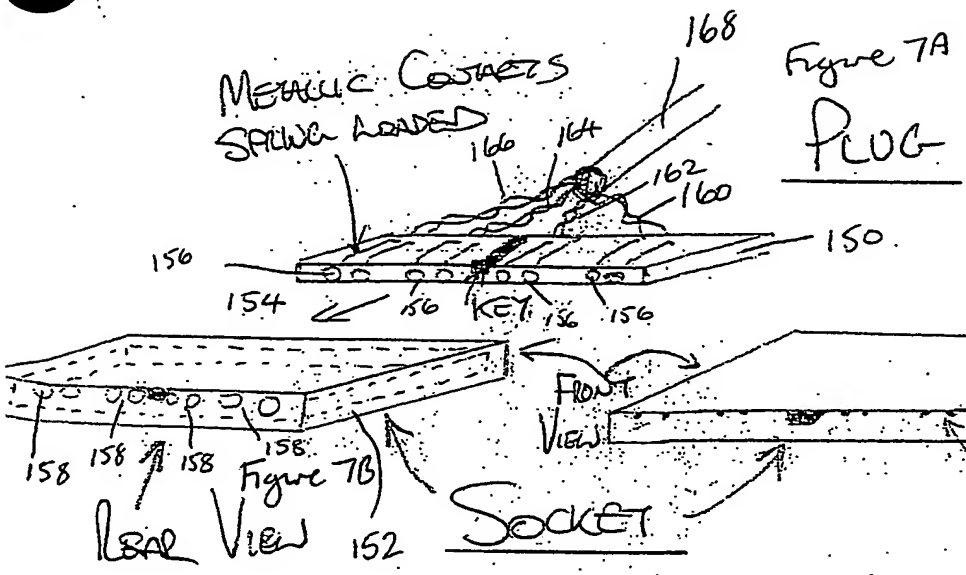


Figure 7A

PLUG

Figure 7B

Figure 7C

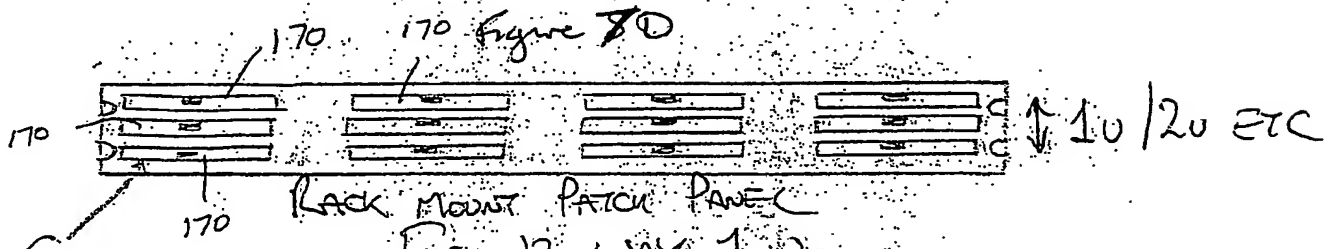


Figure 8D

FOR 12 WAY 10

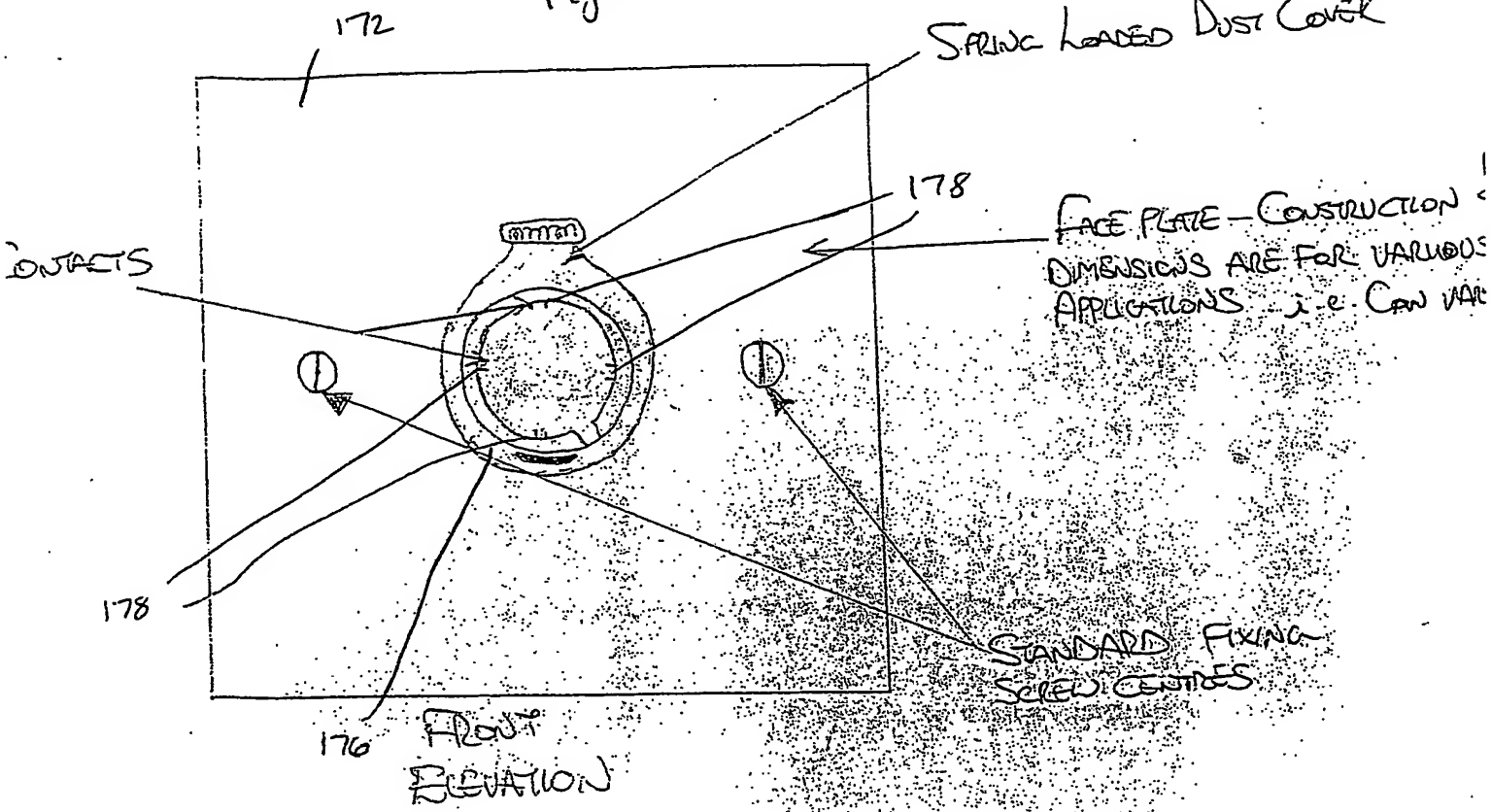
FLAT CAT SOCKET MOUNTED IN PATCH PANEL

NB: EITHER/OR (OR BOTH) THE PLUG & SOCKET MAY BEAR/SPRUNG/STATIC CONTACTS

SURFACE MOUNT SOCKET [illegible]

ROUND TYPE

Figure 8A



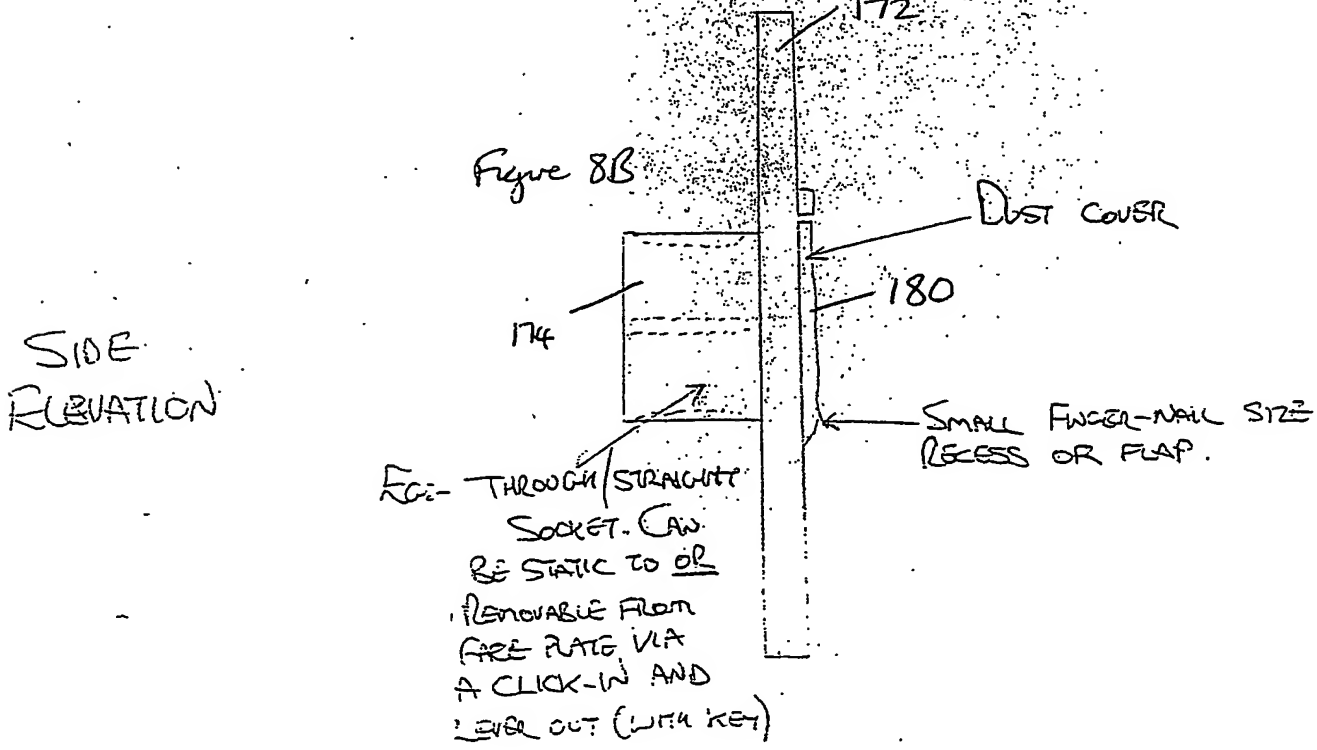
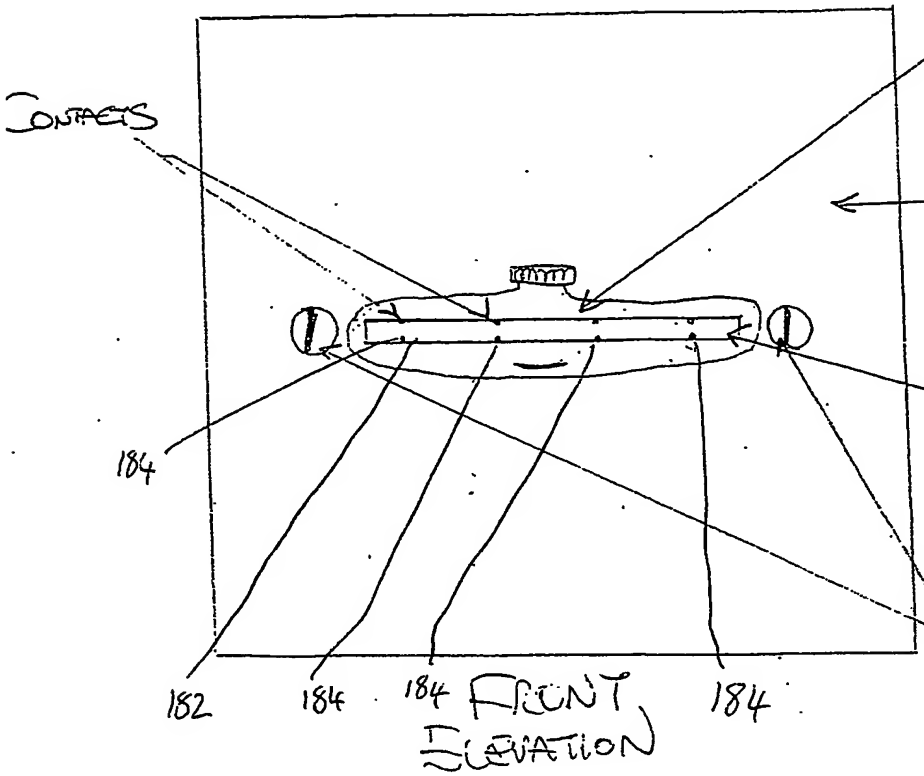


Figure 8B

NOT TO SCALE

SURFACE MOUNT SOCKET FASCIAS (COILED)
FLATCAT TYPE

Figure 9A



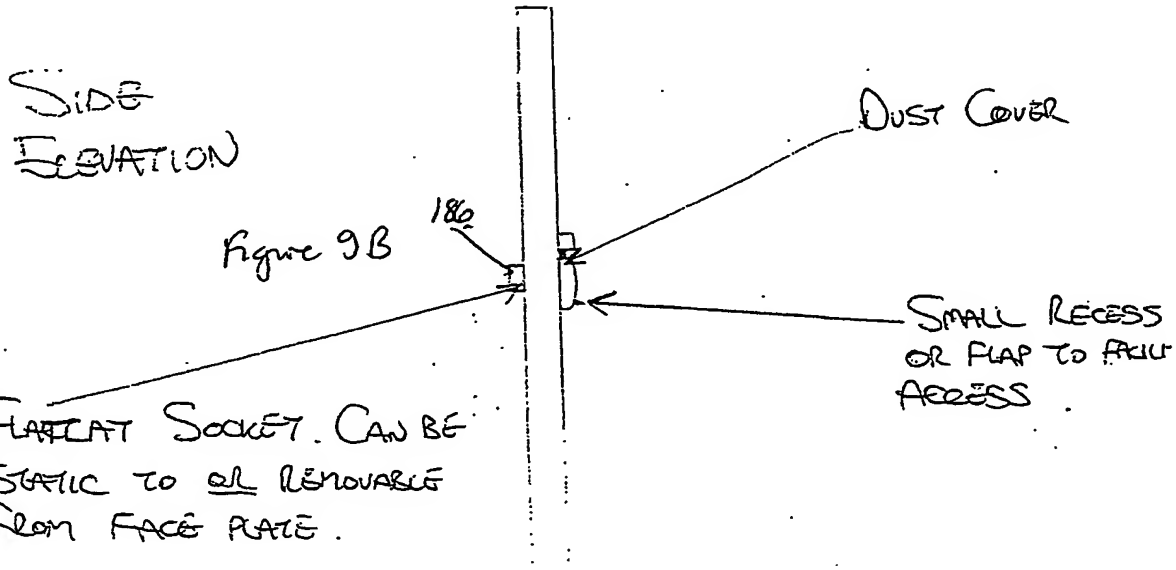
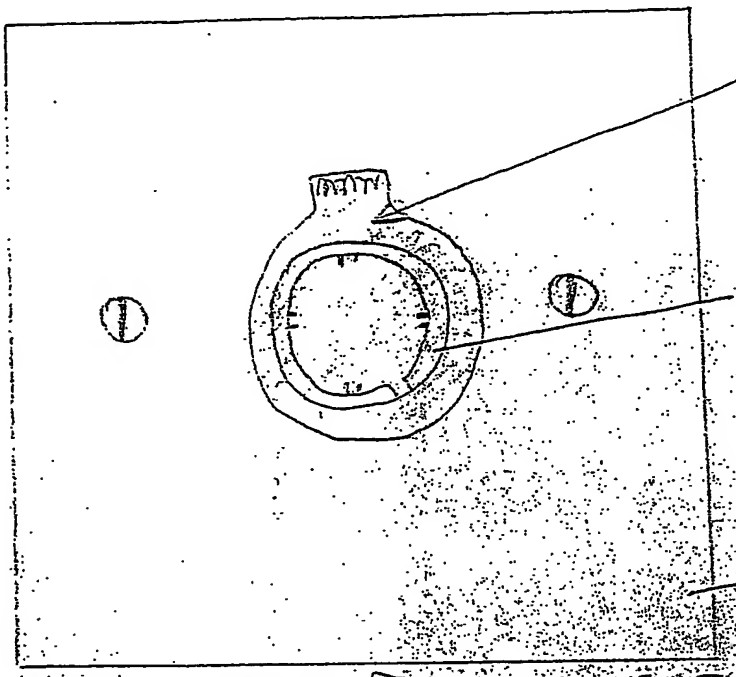


Figure 9B

NB – IT IS LIKELY THAT FLATCAT CAN BE TERMINATED INTO THE ROUND TYPE PLUGS AND SOCKETS AS WELL AS THE FLAT 'PURPOSE-BUILT' (CUSTOM) TYPES.

SURFACE MOUNT SOCKET FASCIAS (OUTLETS)

HYBRID TYPE - THE HYBRID TYPE PLUG & SOCKET ARRANGEMEN
ARE FOR USE WHEN THE CABLE TYPE eg. SLIC OR FLAT CAT 1S TO
CHANGE AT AN OUTLET/PATCH PANEL TO FACILITATE INSTALLATION METH

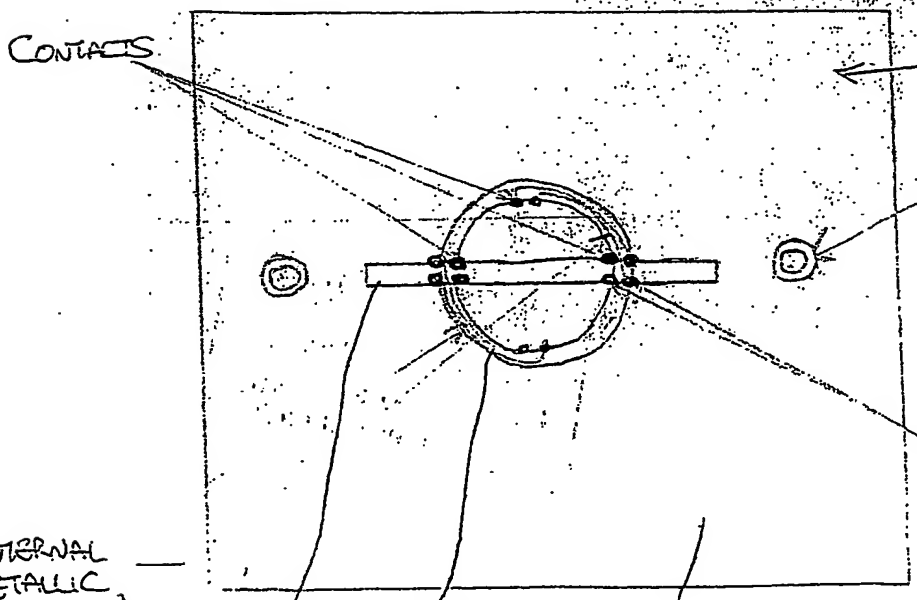


FRONT ELEVATION

Figure 10A

DIAGRAM SHOWS FLATCAT SOCKET TO PATCH PANEL (BELOW)
AND A SLIC OUTLET (ABOVE). THE REVERSE CAN ALSO BE ATTAINED

Figure 10B FACE PLATE



REAR ELEVATION

NB - THE INLETS MARKED WITH RED OUTLINE ARE EXPLAINED AS FOLLOWS:
THE INNER TWO PAIRS ARE INLETS T
'DIRECT' CONTACTS. THE OUTER TWO PA
ARE CONNECTED TO THE UPPERMOST
LOWERMOST CONTACTS VIA INTERNAL
CONNECTION CONDUCTORS.